Farnell

DIGITAL MULTIMETER DM131

INSTRUCTION BOOK

INSTRUCTION BOOK FOR

DIGITAL MULTIMETER DM131

FARNELL INSTRUMENTS LIMITED, SANDBECK WAY, WETHERBY LS22 4DH, YORKSHIRE

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CONTENTS

SCHEDULE OF EQUIPMENT

The instrument has been carefully packed to prevent damage in transit. When removing the unit from the packing box, be sure that all parts and accessories are removed from the packing material.

The complete equipment comprises:—

a) 1 off DM131 (or DM131/B etc.) as ordered

b) 1 off mains lead

c) 1 off pair test leads (red and black) 4mm terminated

d) 1 off pair crocodile clips (with 4mm receptical)

e) 1 off red test prod (with 4mm receptical)

f) 1 off temperature probe (terminated with miniature jack plug) located in hinged box between rear feet

g) 1 off instruction book

h) Any additional accessories specified on order

Note:— In the event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd., within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or missing items should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd., or an agent of this Company.

INTRODUCTION

The DM131 is a 3½ digit six function automatic digital multimeter which, in 21 ranges, measures 100 microvolts to 1000 volts d.c., 100 microvolts to 750 volts r.m.s. a.c., 100 microamps to 2 amps on both d.c. and a.c., 100 milliohms to 20 megohms resistance and $-55^{o}C$ to $+125^{o}C$ temperature.

All functions are selected by a single knob and, with the exception of temperature measurements, input is via two terminals only. Polarity is automatic so there is no need for switching leads around. The temperature measurement is via a probe which consists of a temperature sensing bead and has a semi-rigid supporting sleeve which may be slid back giving extra flexibility to the probe. Connection to the DM131 is via a high-temperature lead terminated in a miniature jack plug.

Ranging is automatically determined and provides maximum resolution for the input level. The unit changes UP range at 1999 and DOWN range at 100. A range 'hold' facility is provided enabling measurements to be taken around full scale (1999) or for nulling applications where constant resolution is required. This facility also increases the scale length to 2999 although the 2 is not displayed and the other 3 digits flash.

Readings are shown on red LED displays of 0.43" (10.92mm) character height and visual indication of function, units being measured, polarity (where appropriate), position of decimal point and (on the mains/battery version) condition of cells is provided. All displays flash if overranged. These facilities eliminate ambiguities and scaling factors.

A precision rectifier is incorporated for a.c. readings which are scaled to read r.m.s. (they are in fact average value readings calibrated in r.m.s. for a sine wave NOT true r.m.s.). A front panel slide switch is used to change to a.c. measurements when on the volts (V) or amps (A) functions.

Input protection against most accidental mis-use is provided on all functions, comprising electronic protection on volts and ohms and a fuse on the current ranges.

The instrument is normally factory preset to operate from an a.c. mains supply of 215–255 volts, 50Hz but can be supplied or adjusted to operate from 110–125 volts, 50Hz. Alternative mains frequencies can be accommodated to special order.

A mains/battery version (DM131/B) is available which permits portable operation from internal rechargeable nickel-cadmium cells. Fast charging and trickle charging are provided internally and are controlled by a slide switch on the rear panel (see operating instructions). Units can be left on both charge rates without damage to the cells.

SPECIFICATION

D.C. VOLTAGE

RANGES (f.s.d.)	±199.9mV . . . . automatic selection ±1.999V . . . . . automatic selection ±19.99V . . . . . automatic selection ±199.9V . . . . . automatic selection ±1000V . . . . . automatic selection
ACCURACY	± (0.1% of reading + 0.05% full scale) on all ranges
INPUT IMPEDANCE	10MΩ on all ranges
RESPONSE TIME	0.5 second (on any one range for a full scale step input function settling to within 0.1% of final reading)
PROTECTION	Up to 1000V peak on all ranges

A.C. VOLTAGE

RANGES (f.s.d. average, scaled to read r.m.s.)	199.9mV . . . . . automatic selection 1.999V . . . . . automatic selection 19.99V . . . . . automatic selection 199.9V . . . . . automatic selection 750V . . . . . automatic selection

ACCURACY

RANGE	45Hz – 1kHz	1kHz – 10kHz
199.9mV	0.25% rdg. + 0.25% f.s.	0.5% rdg. + 0.5% f.s.
1.999V	0.5% rdg. + 0.5% f.s.	0.5% rdg. + 1% f.s.
19.99V	0.5% rdg. + 0.5% f.s.	1% rdg. + 1% f.s.
199.9V	0.5% rdg. + 0.5% f.s.	–
750V	1% rdg. + 1% f.s.	–

Accuracies specified above are ± for readings above 5% f.s. For readings below 5% add ± 5 digits.

INPUT IMPEDANCE	10MΩ shunted by <30pF on all ranges
PROTECTION	Up to 1000V peak on all ranges

RESISTANCE

RANGES	199.9Ω . . . . . automatic selection 1.999kΩ . . . . . automatic selection 19.99kΩ . . . . . automatic selection 199.9kΩ . . . . . automatic selection 1999kΩ . . . . . automatic selection 19.99MΩ . . . . . manual selection
ACCURACY	±(0.2% of reading + 0.05% full scale) except on 2MΩ and 20MΩ ranges which are ±(0.5% of reading + 0.1% full scale)
PROTECTION	Protected against inadvertent application of voltages of up to 250V a.c. or 150V d.c. for up to 2-3 minutes

SPECIFICATION

D.C. CURRENT	
RANGES	±199.9mA . . . . automatic selection ±1999mA . . . . . automatic selection
ACCURACY	±(0.3% of reading + 0.05% full scale) above 500mA applicable for measurement durations of <10sec
SHUNT RESISTANCE	1.2Ω ±5%
PROTECTION	Fused at 2A see page 8
A.C. CURRENT	
RANGES	199.9mA . . . . . automatic selection 1999mA . . . . . automatic selection
ACCURACY 45Hz to 10kHz	±(0.3% reading + 1% full scale) above 500mA applicable for measurement durations of <10 sec
SHUNT RESISTANCE	1.2Ω ±5%
PROTECTION	Fused at 2A see page 8
TEMPERATURE (measurement)	
RANGE	−55°C to +125°C
ACCURACY	±1°C ±0.5% reading
RESOLUTION	0.1°C
PROBE	Semi conductor tip encapsulated in epoxy resin bead and coated with non-toxic paint. Bead size approx. 3 mm diameter x 6 mm long. Thermal capacity 0.25 joules per °C approx. 1.5 m high-temperature lead has sliding glass-fibre based sleeve which converts tip to probe. Lead terminated in a miniature (3.5 mm) jack plug.
GENERAL DATA	
DISPLAY	3½ digits, 7 segment high efficiency red L.E.D. 10.92 mm (0.43") character height
INPUT	Auto polarity. Auto zero.
AUTO-RANGING	Automatic ranging (up at 1999 down at 100) with 'hold' facility to disable auto-ranging when operating around range limits. This provides 50% over-range capability (i.e. up to full scale of 2999 but with 2 not displayed). *N.B. Input should not exceed stated upper range).*

SPECIFICATION

SAMPLING RATE	4 per second
OVERRANGE	All displays flash if overranged (i.e. above 1999)
MAX. COMMON MODE VOLTAGE	500V peak (above earth)
COMMON MODE REJECTION RATIO	>100dB (at 50Hz with 1kΩ source impedance imbalance)
NORMAL MODE REJECTION RATIO	>55dB (at 50Hz)
OPERATING AMBIENT TEMPERATURE RANGE	0 – 40°C
HUMIDITY	80% R.H. max.
TEMPERATURE COEFFICIENT (d.c. volts)	0.005% of reading + 0.005% of range per °C (10°C – 30°C)
CALIBRATION TEMPERATURE	20–23°C
ZERO OFFSET MAX. (After warm-up period on the lowest ranges and additional to spec.)	d.c. volts/current 1 digit a.c. volts/current 5 digits ohms 2 digits ex. lead resistance
POWER SUPPLY REQUIREMENTS	215–255V a.c. mains or 110–125V by internal tap change. 50Hz, 2 watts. Alternative frequency to special order.
BATTERY OPERATION (DM131/B)	Approx. 4–5 hours continuous use when fully charged. Re-charge:– fast – 8 hours. Trickle:– (mains operation) – 16 hours. Flashing L.E.D. indication of low battery. Continuous L.E.D. indication of fast charge.
DIMENSIONS	Width 220 mm Height 80 mm Depth 230 mm Weight 2kg approx. (DM131/B)

OPERATING INSTRUCTIONS

Installation

The DM131 is normally supplied set for use with a.c. mains supplies of nominal 230V, 50Hz. Check that the instrument supplied is suitable for the local mains supply. Units which leave the factory set for nominal 115V, 50Hz inputs bear an additional label on the back panel.

To change from 230V to 115V supply setting

1) ensure that the mains and input leads are disconnected

2) remove covers as detailed on instrument back panel

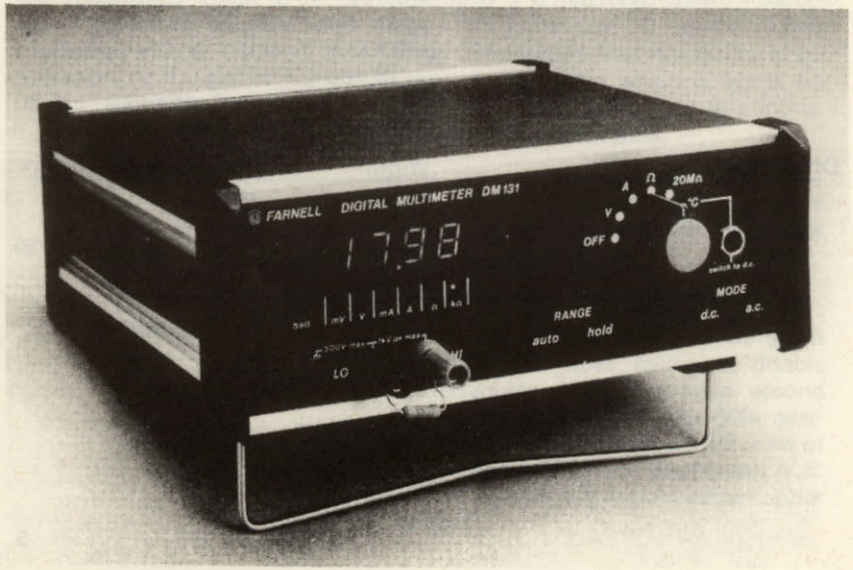
3) DM131 (mains only version):— Unsolder brown wire leading from mains switch section of function switch at the 230V position marked on the small circuit board on the back panel. Resolder to the 115V tag.

   DM131/B (mains/battery version):— Unscrew terminal holding brown wire leading from mains switch at the terminal block on the side of the battery support bracket. Refix to adjacent terminal.

4) mark the unit to indicate 115V operation only

The three core mains lead should be connected as follows:—

Brown	—	mains LIVE
Blue	—	mains NEUTRAL
Green/yellow	—	earth



Operation

Connect the mains lead to the instrument and to the mains supply. On the DM131/B select 'MAINS' on the rear panel switch marked 'BATT-MAINS — FAST CHARGE' unless it is intended to operate from the batteries, in which case select 'BATT' on rear panel slider switch.

The operation of the instrument has been kept as simple as possible, the only controls being the function switch, range auto/hold switch and the d.c./a.c. mode switch.

CAUTION

When making voltage measurements ensure that the source signal does not include high voltage spikes in excess of 1000 volts peak and always remove input from multimeter before disconnecting mains.

Measuring d.c. volts

Select 'V' on function switch, 'auto' on range switch and 'd.c.' on mode switch. The display should light up.

Connect the two test leads to the appropriately coloured terminals using the *short* 4mm plugs, attaching a probe and croc. clip to the other ends. On shorting the leads a reading of 00.0mV (±2 digits after 30 minutes warm-up worst case) should appear.

Connect the leads to the voltage to be measured and the unit automatically selects the most appropriate one of 5 ranges and displays the value of the applied input voltage. For example, for 1.6V the 2V range will be selected and the reading will be 1.600V.

The unit up-ranges at a count greater than 1999 giving a reading of greater than 200 on the next highest range, and down-ranges at less than 100 giving a reading less than 1000 on the next lowest range. The reason for the overlap is to prevent annoying range changes for slightly varying readings.

A particular range may be held by selecting 'hold' on the range slide switch. This is useful for maintaining constant resolution for curve plotting or in nulling applications where a change to greater sensitivity can give the impression that the null point has been traversed. The range 'hold' switch should always be returned to 'auto' when not needed otherwise the instrument may select any range at random during switch on.

When a range is held and a count of 1999 is exceeded the display will flash on and off to indicate overrange. However the unit will still function up to a count of 2999 but the 2 will not be displayed. For example, if it is known that the voltage to be measured lies between a count of 1999 and 2999 an extra decade of resolution is available i.e., 2.5V would be read as .500 (display flashing) — the 2 being 'understood' and not displayed.

The d.c. voltage range is protected up to 1000V even if a lower range is held. However, voltages in excess of 1000V may cause serious damage to the instrument and should be avoided. Note also that the 'LO' terminal (black) must not be taken more than 500V above earth (case) potential.

It is advisable that high voltages (above 100V) are not measured on the mains/battery version (DM131/B) unless the case is earthed — normally via the mains lead.

Measuring d.c. current

Switch function switch to 'A', range switch to 'auto' and mode switch to d.c. Connect leads to instrument as described for d.c. voltage measurement. Connect leads in series with the current to be measured. The result will be displayed together with annunciation of the measurement units – either mA or A.

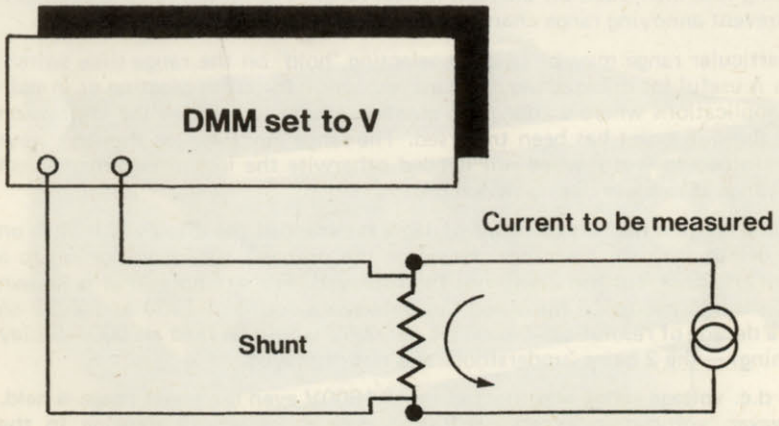
Protection of the internal shunt (nominally 1.2Ω) is provided by a 2A 20mm x 5mm fuse located in the right hand side panel (viewed from the front) under the carrying handle. It may be removed by turning the screw about half a turn. The fuse and carrier screw will then spring out.

Replacement fuse: 2A 5x20mm super quick acting type only. Manufacturer: Schurter, part number SA0340904

When continuously measuring currents of greater than 500mA the internal shunt will heat which can result in a reduction of accuracy. It is therefore recommended that only short period (<10 secs.) measurements are taken above 500mA. For continuous measurements an external 0.1Ω shunt is recommended with the unit switched to volts. The DM131 will autorange to 200mV range and to read current in mA the display is x10. To read amps the display is ÷100.

When using the instrument with the optional external current shunts, switch to d.c. volts (V) and connect the current shunt leads to the input terminals. The reading for the 20A shunt is now divided by 10 giving the correct reading in amps (ignore the mV annunciation). For the 200A shunt the reading is directly in amps (ignore the mV annunciation).

Using external current shunts



Measuring resistance

Switch the instrument to 'Ω'. Without resistance connected to the input leads the instrument ranges up to the highest range (1999kΩ) and then flashes to indicate open circuit resistance (above 2MΩ). The actual reading under these conditions will be a flashing number above 1100.

Connect the unknown resistance across the test leads and the display and units annunciation will indicate its value. Warm up time for best accuracy is 30 minutes.

On the lowest range (200Ω) the test leads and/or connections may yield a small residual resistance. The leads should be shorted together and the residual reading (for example 0.2Ω) subtracted from any measurements taken on this range.

On the Ω ranges the maximum voltage drop across the unknown resistance is 200mV and will not in general turn ON a semiconductor junction (i.e. when forward biased).

The 20MΩ is a fixed range and no annunciator illuminates. Voltage drop across the unknown resistance on this range at full scale is 2V. Note that when measuring high resistances on long leads or with large electromagnetic fields it is possible to encounter a.c. pickup which may produce an erratic reading. This may be minimised by guarding or screening the unknown resistance and the connecting leads to either the LO terminal or to earth.

The resistance ranges are protected against inadvertent application of voltage to the input terminals. However, since the voltage at the input is dissipated across an internal resistance this may cause excessive heating of the instrument if the voltage is left connected for more than a few minutes.

Measuring temperature

Important notes:–

1. The temperature probe is housed in container under the base of the instrument.

2. Probes are not interchangeable from one unit to another without calibration.

3. The probe tip may be permanently damaged if the instrument's measurement range is exceeded.

4. It is necessary to remove the temperature probe jack plug when reverting to measurements on other functions.

With the mode switch in the d.c. position switch to '^{O}C' leaving the LO and HI terminals completely disconnected. Plug the jack plug of the temperature probe/lead/plug assembly into the jack socket on the front panel. The temperature of the probe tip is now displayed. Note that no annunciation is provided as the temperature operates on a single range of −55 to +125^{O}C.

The temperature sensing element – a micro transistor – is located in an 'araldite' bead at the end of the probe and care should be taken not to damage it. The sleeve on the cable supports the tip for use as a hand held probe but where spot temperatures are required (e.g. heatsinks, transistors etc.) the sleeve may be slid away leaving the low mass tip free on the reasonably flexible lead. The tip may be held on to the component being tested or in awkward locations with 'plasticine' up to moderate temperatures.

The temperature probe lead may be lengthened with an extension lead made from a 3.5mm free miniature jack socket at one end and a 3.5mm free miniature jack plug at the other. Ensure that the plug tip is connected to the corresponding terminal on the socket. All components used for extensions must be fully insulated.

Measuring a.c. voltage and current

Follow the same procedure as in d.c. voltage and current but select 'a.c.' on the mode switch.

If the a.c. source is high impedance invalid readings may occur due to pickup from stray electromagnetic fields. Screened input leads to earth or the LO terminal should prevent this. A 4mm to b.n.c. socket adaptor, as provided in the optional de-luxe probe kit, is particularly useful for this purpose.

Due to the high input impedance and fast response time it is sometimes possible for a 'noisy' reading to occur under conditions of high input voltage and/or low frequencies. This noise is normally 3–4 digits of the least significant digit and the actual reading is the mean of maximum and minimum readings. Also when measuring 240V mains voltages the neutral should be connected to the 'LO' terminal to reduce any mains cycling effects.

The DM131 measures the average of the a.c. input and is scaled to read the r.m.s. value of a pure sine wave. To measure square waves multiply reading by 0.903. For triangular waveforms multiply by 1.034.

Allow a 30 minute warm up period for best accuracy.

Please note that when operating on batteries with the mains lead disconnected, the case of a DM131/B should be earthed if measuring high voltage or current at high frequencies. This is to screen any pickup effect. If the batteries are fully charged they exhibit a slight overvoltage which can affect the a.c. zero. This disappears within a few minutes.

DM131/B Mains/battery version

Approximately 4–5 hours continuous use is available when operating from the integral battery pack. This represents a considerable number of individual measurements if the unit is turned OFF after each reading as with a portable calculator. Good accuracy will still be achieved with intermittent use but for optimum performance a warm up period of 30 minutes is recommended.

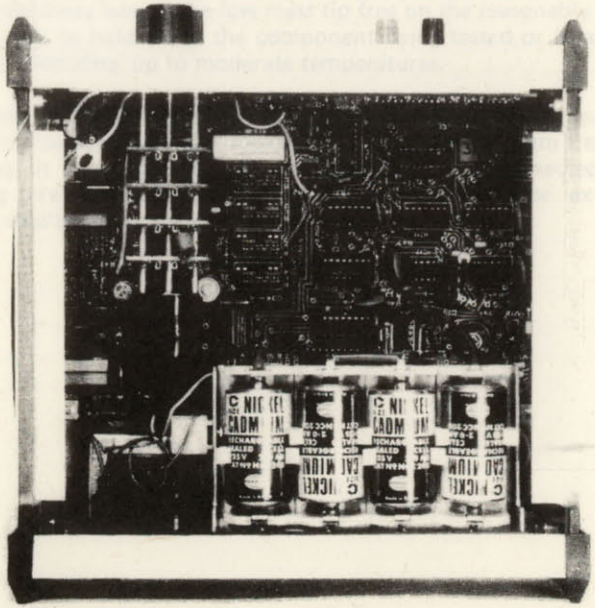
Fast charging – Unit must be switched ON to any function, and connected to the mains, for fast charging with the switch on the back panel set to 'FAST' charge. Approximately 8 – 10 hours are needed to fully re-charge completely discharged cells.

Trickle charging – The DM131/B is trickle-charged automatically whenever the unit is being operated (i.e. switched ON) and is connected to the mains for normal use (i.e. the rear panel switch set to 'MAINS'). (Approx. 16 hours to fully re-charge).

The unit can be left on either charge rate without damage to the cells.

It is recommended that to obtain a long life from the NiCd cells they are periodically 'worked'. They should not be left unused in a fully charged or discharged condition.

NOTE:– When using the instrument on batteries remove the mains supply from the unit to prevent common mode error on a.c. measurements.



CIRCUIT DESCRIPTION

The DM131 features m.o.s., l.s.i. and complex function t.t.l. integrated circuits (ICs) to provide a sophisticated system with relatively few devices. This enhances reliability and reduces the size of the instrument.

The power supply is located on the back panel of the instrument providing 5V d.c. at 500mA and comprises a transformer, rectifier and integrated circuit voltage regulator. Short-circuit proof automatic fold-back current limiting is provided and overvoltage protection is by a series fuse (20mm 500mA) and a zener diode. If this fuse fails it usually indicates a major failure.

In the mains/battery version (DM131/B) the power supply is also on the back panel together with the battery pack. Additional charging circuitry is provided controlled by a slide switch on the rear panel. An oscillator and comparator are also incorporated so that if the battery voltage drops below a set level, the battery low warning indicator on the front panel (annunciator marked 'batt') flashes. This annunciator is in-operative on the mains only version, of course.

A d.c. to d.c. converter is located on the main circuit board and steps up the 5V input from the power supply to +12V and –12V to drive the analogue and m.o.s. devices.

The analogue to digital converter is a pair of m.o.s. integrated circuits one of which is an analogue processor and the other the digital processor. The analogue processor works from an input of 200mV to give a full scale reading of 2000 counts.

The principle of operation is the quantised charge accumulation technique. A current proportional to the input voltage is fed into a summing integrator. The other input is fed by a current proportional to the reference voltage (derived from a temperature compensated zener diode) which is pulse width modulated by the internal control logic. A balance is maintained and a counter keeps tally of how many times the reference supply was connected to maintain this balance. The count is thus proportional to the input voltage. Prior to the measuring cycle described above, an auto-zero cycle is executed which connects the input amplifier to zero volts and causes its output to be stored. This stored offset is used as an additional input to the summing integrator, automatically compensating for zero drift. An external clock controls the sampling rate and is arranged to have a whole number of mains periods in one sample thus giving good rejection to mains interference. At a count of greater than 1999 an encoded overrange signal appears at the output of the digital IC. This is decoded and used in the autorange circuit. Similarly at counts of less than 100 an encoded underrange signal is used in the autorange circuit.

A thin film attenuator (nominal impedance 10MΩ) is used to attenuate the input voltage to 200mV f.s. on both a.c. and d.c. It is tapped to give four decades of division. Selection of the tapping point is made by reed relays which are driven by a shift register whose clock and reset are derived from the overrange and underrange signals respectively.

The same attenuator and reed relays are used to form and select sensing resistors for a constant current source in the OHMS mode. The currents are arranged to give 200mV drop at full scale on all ranges except the 20MΩ range where the drop is 2V.

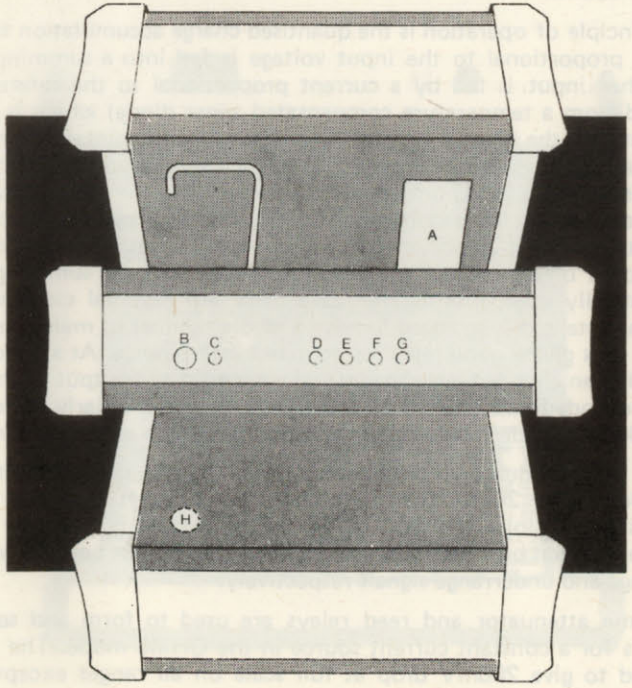
The precision rectifier converts a.c. to d.c. and comprises a high input impedance f.e.t. buffer amplifier, full wave rectifier and integrator amplifier scaled to read r.m.s. value of a sine wave.

A shunt resistor of 1.2Ω is switched across the input and the voltage developed across it scaled and read by the voltmeter as CURRENT.

The temperature measurement consists of a constant current source feeding a base-emitter junction of a transistor (encapsulated in the probe) the voltage across which varies linearly with temperature. This voltage is measured with its voltage at zero ^{o}C subtracted from the reading, thus giving zero output at zero ^{o}C.

ADJUSTMENT POINTS FOR RE-CALIBRATION

A. Temperature probe housing
B. Current protection fuse 2A F1
C. Set d.c. voltage ref. pot. P5
D. Resistance ref. pot. P1
E. Zero a.c. pot. P3
F. A.C. cal. f.s. P4
G. Temp. 0^{o}C pot. P6
H. Remove top cover to set current pot. P2



RE-CALIBRATION

A precision thin-film attenuator network is used for voltage and resistance measurements. Apart from providing excellent long term stability and temperature coefficient it means that calibration checks are only necessary at intervals of about 6 months.

There is only one trimming potentiometer for each measurement function except a.c. which has two. This means that a quick re-calibration check using any known voltage or resistance can be made. The trimmers can be set up for this one known reference point and one can assume that all other points are correct.

However, in the event of component replacement or the need for a more precise check of calibration the following procedure should be followed.

EQUIPMENT REQUIRED

d.c. volts range

Reference source that can be set to 190.0mV, 1.900V, 19.00V, 190.0V and 1000V, i.e. approximately full scale. This d.c. reference source should have an accuracy of 0.01%.

Ohms range

Resistance box capable of achieving 0.1% accuracy over the ranges 199.9Ω, 1.999kΩ, 19.99kΩ, 199.9kΩ, 1999kΩ (i.e. 2MΩ) and 19.99MΩ (i.e. 20MΩ).

a.c. volts range

Ref. source of 0.1% amplitude accuracy to cover ranges as for d.c. to a maximum of 750 Va.c. Calibration is sine wave calibrated for r.m.s. For low frequency re-calibration (45Hz to 1kHz) the source accuracy should be 0.1% to 0.2%. For frequencies between 1kHz and 10kHz, 0.5% source accuracy is recommended.

Current range

Reference source to supply 199.9mA and 1.999A d.c. and a.c. with an accuracy of 0.1%.

Temperature range

Melting ice made from pure distilled water. A calibrated thermometer of 0.1% accuracy covering the range −55 to +125^{o}C. Temperature 'source' covering same range i.e. temperature controlled oven or refrigerator.

Note that temperature probes are not directly interchangeable without slight re-calibration.

Always remove temperature probe when reverting to other measurement functions otherwise overrange will be indicated.

PROCEDURE

The range slide switch should be in the 'auto' position for all re-calibration checks.

d.c. volts

Set d.c. voltage potentiometer P5 so that display corresponds to input from reference source of ±190.0mV.

Check all other ranges for calibration ±(0.1% of reading + 0.05% f.s.)

Check zero with terminals shorted out for ±2 digits after warm up.

The ±190.0mV range must always be calibrated first as the other ranges will depend on this setting.

In a full re-calibration check take readings every decade ±. and check against source.

Ohms

Switch to ohms ('Ω'). Set P1 so that the display corresponds to 1.900kΩ set on the resistance box.

Check other ranges for linearity and accuracy.

Check manual 20MΩ range.

a.c. volts

Set mode switch to a.c. Short input terminals with link. Adjust P3 for zero.

Apply source at say 100Hz at 150.0mV and adjust P4 so that the reading concurs.

Check all voltage ranges at frequencies from 45Hz to 1kHz and three lowest from 1kHz to 10kHz.

If frequency response lies outside the specification limits return to factory for re-calibration.

Current

Switch to amps ('A'). Reset mode switch to d.c. Set reference source to 190.0mA. Remove top cover of instrument, following instructions printed on rear panel. Adjust P2 (adjacent to current fuseholder at front right of main board) so that reading corresponds with source.

Switch to a.c. mode and using a reference source of a.c. current check that reading corresponds.

Temperature

Disconnect any leads to main input terminals. Switch to d.c. mode and select '^{O}C' on function switch. Insert jack plug of temperature probe assembly into the socket on the front panel. Ensure water and ice is stirred and set display to 00.0 (±5 L.S.D.) using P6.

Linearity is set by S.O.T. (select on test) resistor R47 and should not normally require re-setting unless a new probe is fitted.

Check readings against calibrated thermometer and source to −50 to +125^{O}C.

Note: Probes are not interchangeable from one unit to another without calibration.

B.C.D. SPECIFICATION FOR DM131 OPTION (DM131/B.C.D.)

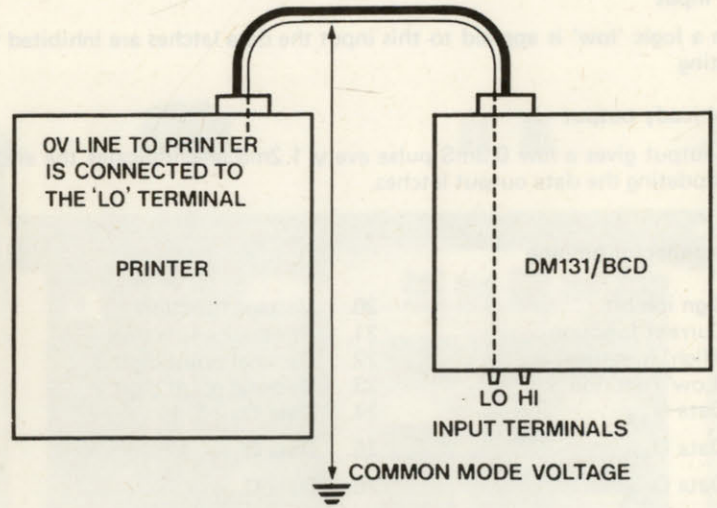
General

B.C.D. outputs are provided as an option on the DM131 and take the form of a thirty seven way plug and socket on the rear panel of the instrument. This option is not available with the battery version.

The outputs are not isolated from the multimeter 'LO' input terminal, giving rise to two important application considerations.

a) Voltages applied to the 'LO' terminal must not exceed the maximum common mode voltage of the external equipment.

b) If the power supply of the external equipment supplied with the B.C.D. information were to be grounded then the 'LO' terminal would also be at ground.



Data outputs

B.C.D. 1–2–4–8 coded, positive true. 2 T.T.L. loads.

Logic one: +2.4V
Logic zero: +0.4V

Over-range

Logic 'low' normally. Logic 'high' when over-ranged.

Sign

Logic 'high' for positive
Logic 'low' for negative

Sign inhibit output

The sign for the a.c. and resistance ranges is inhibited
Logic 'low' – sign inhibited

Decimal points

Logic 'low' when on

Function outputs

Voltage current resistance	Logic 'low' when annunciated
'High' function (i.e.) Volts kΩ amps	" " " "
'Low' function (i.e.) mV Ω mA	" " " "

Range selected outputs

Logic 'low' when range selected

Hold input

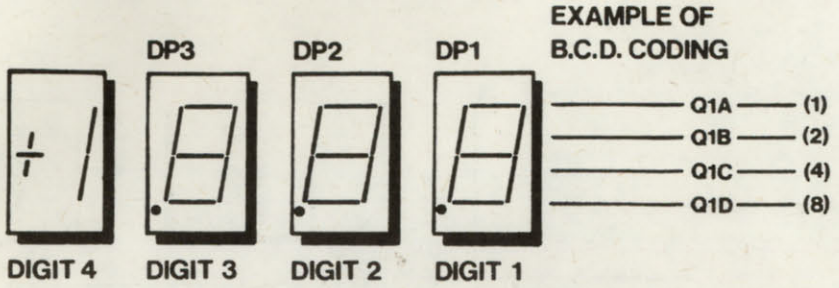
When a logic 'low' is applied to this input the data latches are inhibited from updating

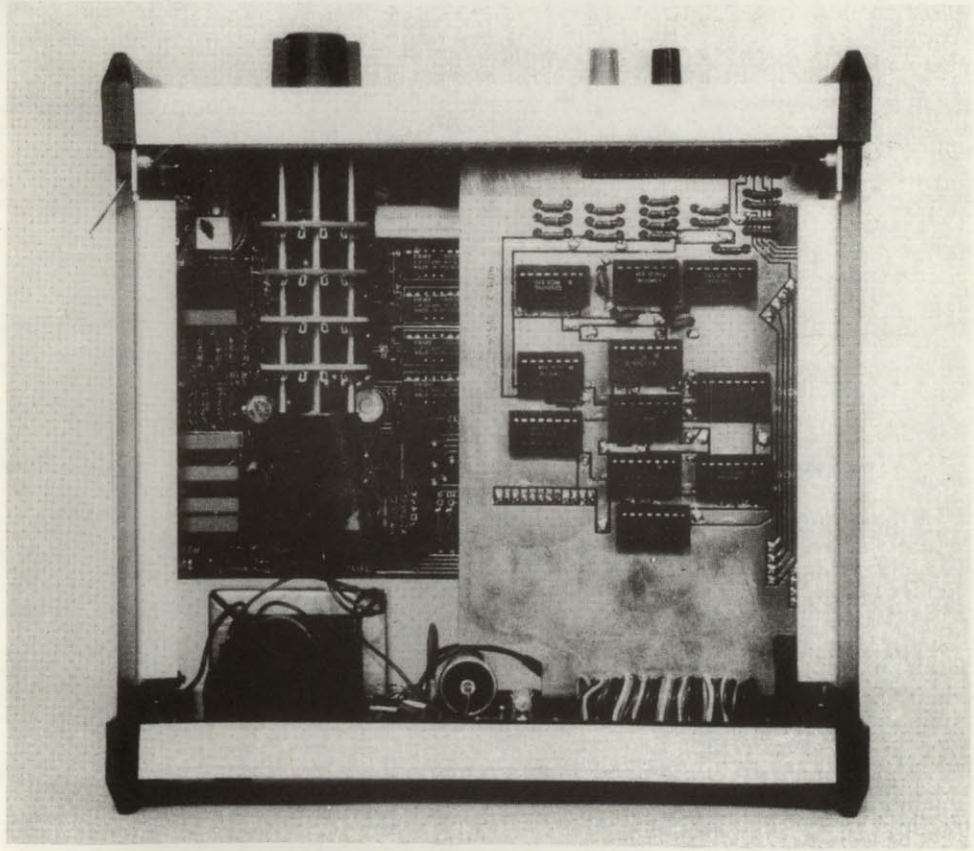
Signal ready output

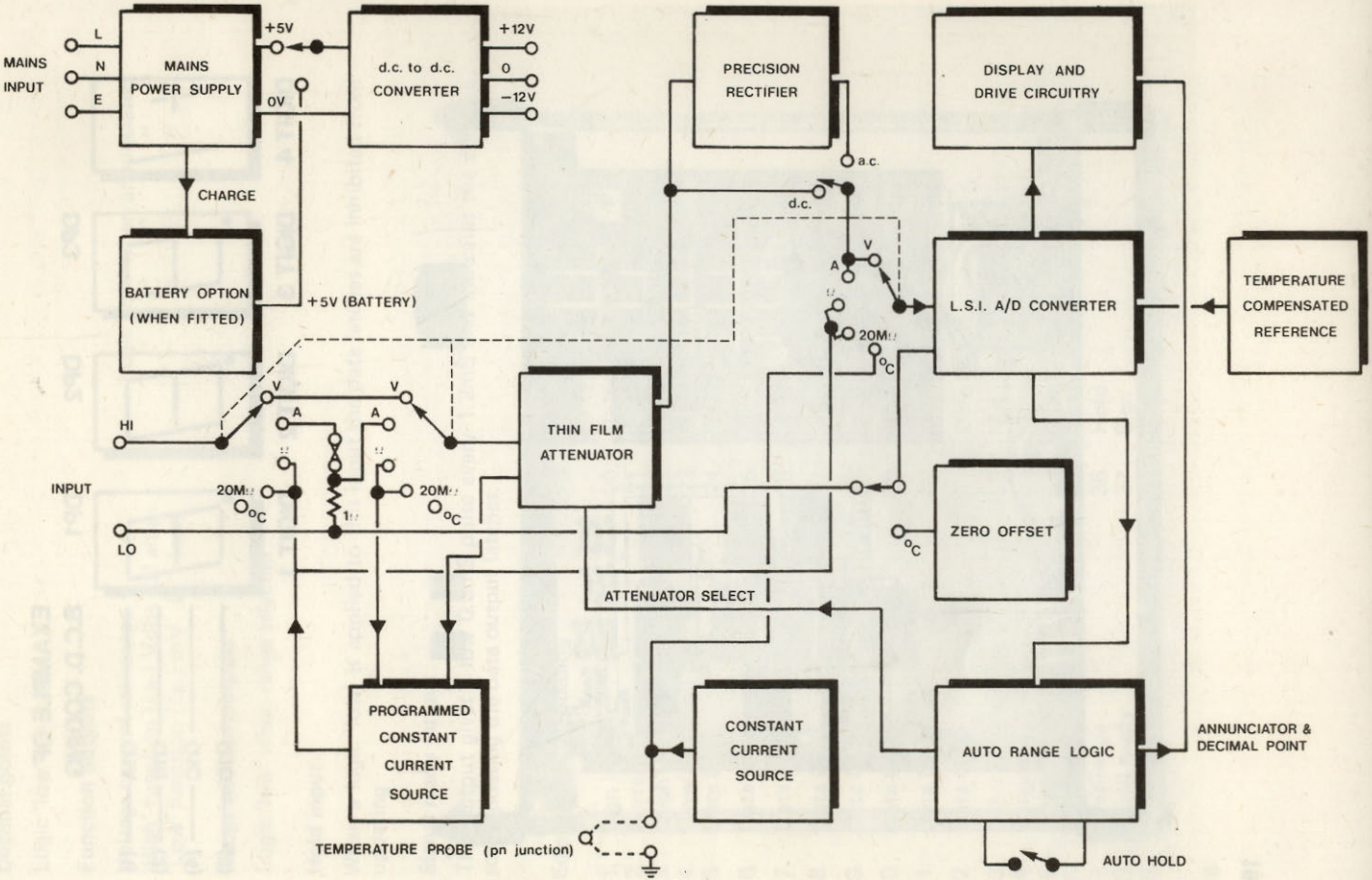
This output gives a low 0.3mS pulse every 1.2mS and indicates the end of a scan updating the data output latches.

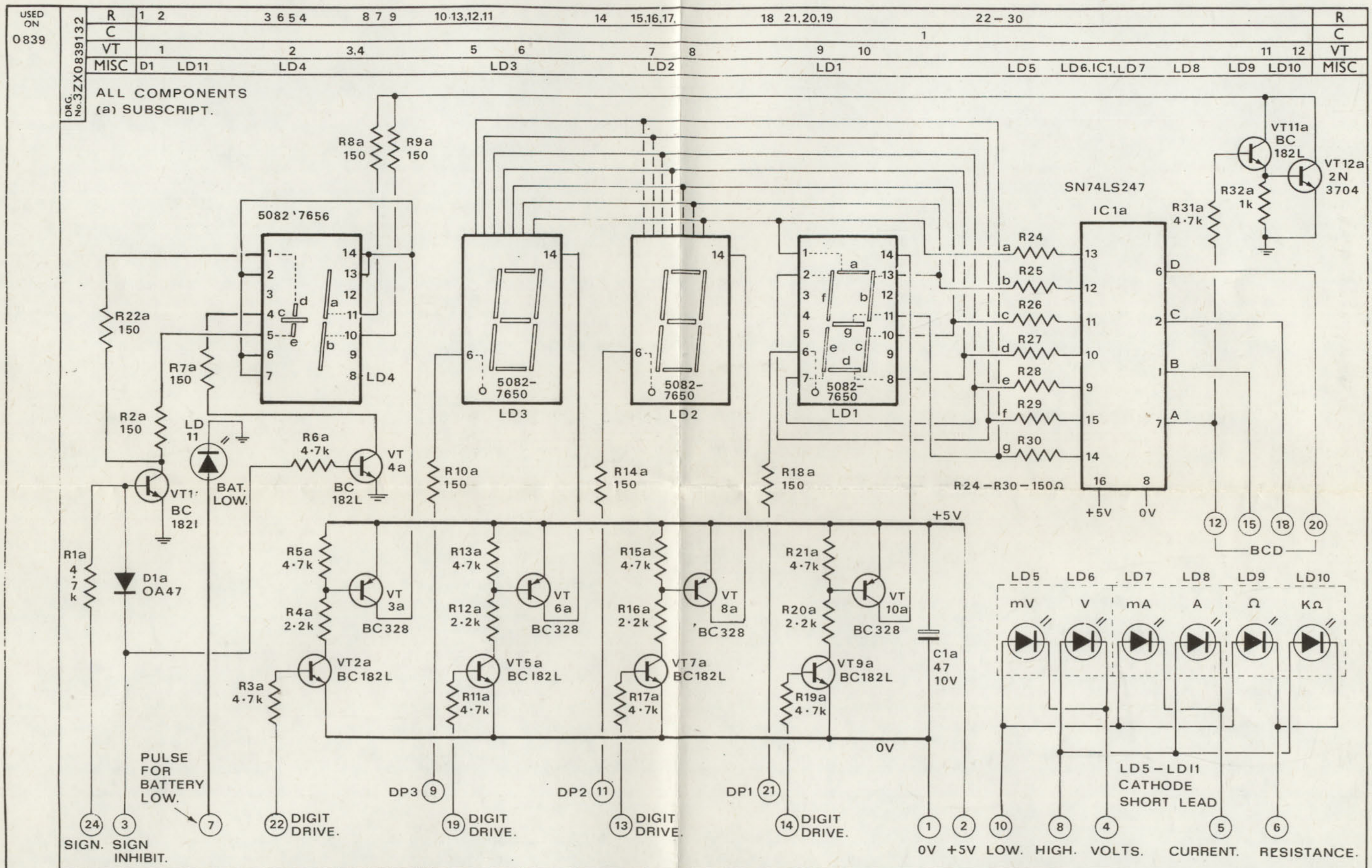
Edge connector pinning

1.	Sign inhibit	20.	Voltage function
2.	Current function	21.	Resistance function
3.	'High' function	22.	Decimal point digit 3
4.	'Low' function	23.	Decimal point digit 2
5.	Data Q_{1A}	24.	Data Q_{1B}
6.	Data Q_{1C}	25.	Data Q_{1D}
7.	Data Q_{2A}	26.	Data Q_{2B}
8.	Data Q_{2C}	27.	Data Q_{2D}
9.	Data Q_{3A}	28.	Data Q_{3B}
10.	Data Q_{3C}	29.	Data Q_{3D}
11.	Data Q_{4A}	30.	Data Q_{4B}
12.	Data Q_{4C}	31.	Data Q_{4D}
13.	OV	32.	Not used
14.	Range 3	33.	Range 2
15.	Range 1	34.	Range 4
16.	Range 5	35.	+5V
17.	Over-range	36.	Hold
18.	Signal ready	37.	Sign
19.	Decimal point digit 1		






MAINS INPUT
L
N
E
MAINS POWER SUPPLY
+5V
0V
d.c. to d.c. CONVERTER
+12V
0
−12V
CHARGE
BATTERY OPTION (WHEN FITTED)
+5V (BATTERY)
PRECISION RECTIFIER
DISPLAY AND DRIVE CIRCUITRY
a.c.
d.c.
V
A
L.S.I. A/D CONVERTER
TEMPERATURE COMPENSATED REFERENCE
20MΩ
°C
HI
INPUT
LO
THIN FILM ATTENUATOR
1Ω
ZERO OFFSET
ATTENUATOR SELECT
PROGRAMMED CONSTANT CURRENT SOURCE
CONSTANT CURRENT SOURCE
AUTO RANGE LOGIC
ANNUNCIATOR & DECIMAL POINT
TEMPERATURE PROBE (pn junction)
AUTO HOLD



USED ON 0839
DRG. No. 3ZX0839132
R
C
VT
MISC
D1 LD11 LD4 LD3 LD2 LD1 LD5 LD6.IC1.LD7 LD8 LD9 LD10
ALL COMPONENTS
(a) SUBSCRIPT.
5082 7656
LD4
5082-7650
LD3
LD2
LD1
SN74LS247
IC1a
R24 – R30 – 150Ω
VT11a BC 182L
VT12a 2N 3704
R32a 1k
R31a 4·7k
R8a 150
R9a 150
R22a 150
R7a 150
R2a 150
LD 11
BAT. LOW.
R6a 4·7k
VT 4a BC 182L
VT1 BC 182l
R1a 4·7k
D1a OA47
R10a 150
R14a 150
R18a 150
+5V
0V
R5a 4·7k
R4a 2·2k
VT 3a BC328
VT2a BC182L
R3a 4·7k
R13a 4·7k
R12a 2·2k
VT 6a BC328
VT5a BC182L
R11a 4·7k
R15a 4·7k
R16a 2·2k
VT 8a BC328
VT7a BC182L
R17a 4·7k
R21a 4·7k
R20a 2·2k
VT 10a BC328
VT9a BC182L
R19a 4·7k
C1a 47 10V
BCD
LD5 LD6 LD7 LD8 LD9 LD10
mV V mA A Ω KΩ
LD5 – LD11
CATHODE
SHORT LEAD
PULSE FOR BATTERY LOW.
SIGN.
SIGN INHIBIT.
DIGIT DRIVE.
DP3
DP2
DP1
0V +5V LOW. HIGH. VOLTS. CURRENT. RESISTANCE.

TRACED				
CHECKED	(signature)			
DRAWN	J.N.	ISS.	DATE 2:8:77	MOD. No

NOTE –
CAPACITOR VALUES GIVEN IN μF
RESISTOR VALUES IN Ω
(2) REFERS TO CCT. BD. PIN CONNECTION Nos. ON MAIN BOARD.

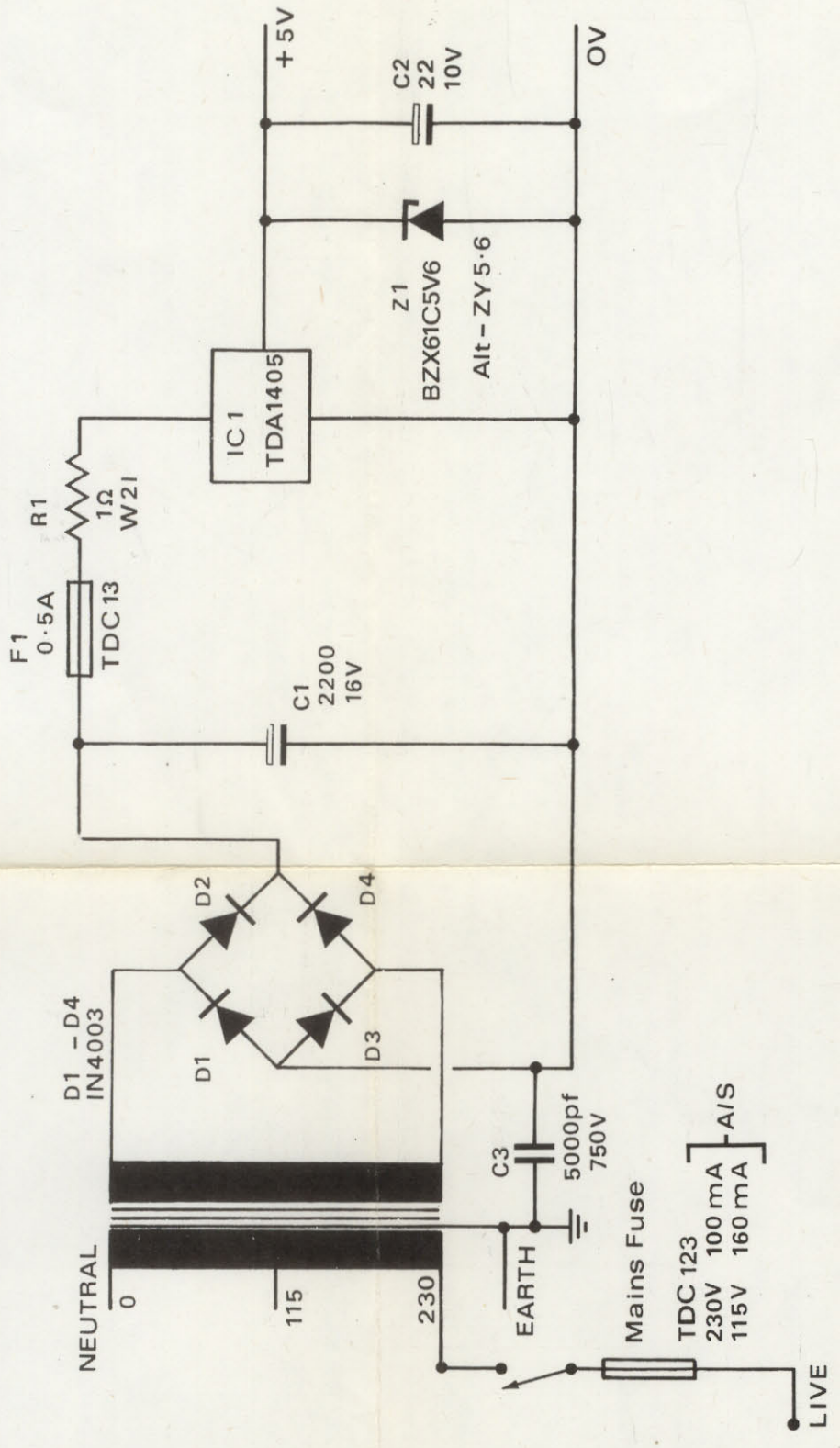
FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

CIRCUIT DIAGRAM
DISPLAY BOARD DM131
FROM BATCH 20 ONWARDS

DRAWING No. 3ZX0839132

DRAWING No. 4ZX0839134

USED ON



ISS.	DATE	MOD. No.
A	10-10-77	

PROTECTIVE FINISH

MATERIAL

NOTE: REMOVE ALL BURRS AND SHARP EDGES

TRACED

CHECKED

DRAWN S A

TOLERANCES

SCALE

DIMENSIONS IN M.M.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

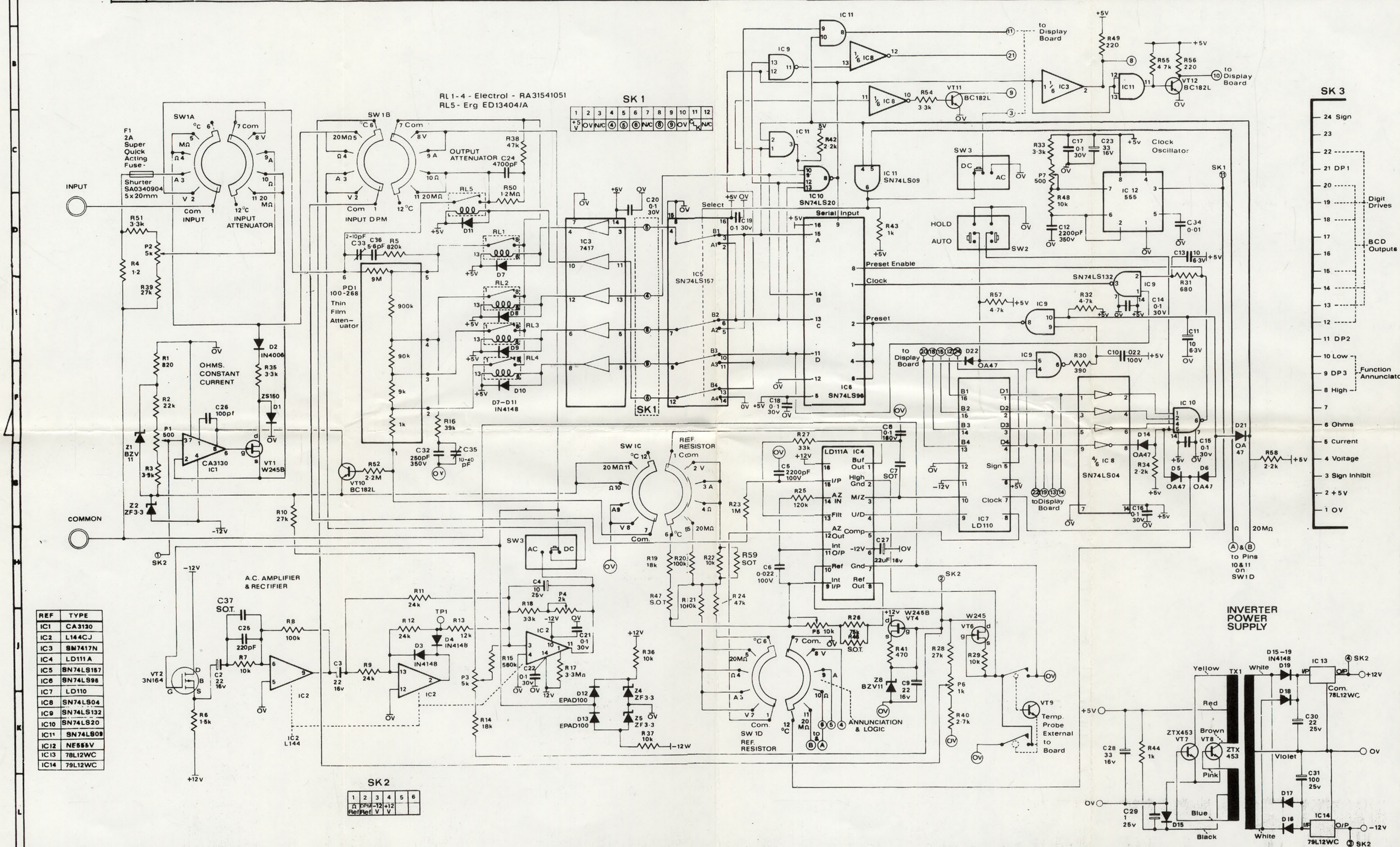
TITLE: CIRCUIT DIAGRAM POWER SUPPLY DM131

DRAWING No. 4ZX0839134

SHEET 1 OF 1 SHEETS

GAF 3363/72

DRAWING No. 1ZX0839131		
R		4,51,39,1,2,3,6 7 35 8,10 52,9 5 12,11 16 13 14,15,50,30,38,18 17 36 37 47 19 20,21,24,22,23 59 27,25,42 26,46 43 41 54 28,40. 29 57 33,48,30,32 49 44 34 55 56 31 58 45
C		26,2 25 37 3 33 36 32 35 24 22 4 21 20 19 5,6 18 27 7,8,9 12 17 11,23 28,14,16,29 10 34,15 13 30,31
VT		2 1 10 4 6 9 7 8
USED ON	MISC	Z1,2,F1,IC1,P1,2,SW1A,D2,1 IC2 Sk2,PD1, SW1B,D3,4,P3,RL5,1,2,3,4,D11,7,8,9,10,SW3,P4,IC3,D12,13,Z4,5,SK1,SW1C,IC5. SW1D,IC9,11. P5,IC10,6,4,Z8 D22 VT11,P6,IC7,SW3,2. P7 IC3 VT12,IC8,12,D14,5,6,15. D21,TX1 D19,18,17,16,Z7 IC13 Sk3



REF	TYPE
IC1	CA3130
IC2	L144CJ
IC3	SN7417N
IC4	LD111A
IC5	SN74LS157
IC6	SN74LS96
IC7	LD110
IC8	SN74LS04
IC9	SN74LS132
IC10	SN74LS20
IC11	SN74LS09
IC12	NE555V
IC13	78L12WC
IC14	79L12WC

SK2					
1	2	3	4	5	6
Ω Ref	DPM Ref	-12 V	+12 V		

TRACED	D	14 12 77	4490
CHECKED	C	9 12 77	Q4484
	B	18-11 77	Q4413
DRAWN 8A	A	9·6·77	
	ISSUE	DATE	MOD. No

NOTE
REMOVE ALL BURRS AND SHARP EDGES

TOLERANCES

MATERIAL

SCALE

PROTECTIVE FINISH

DIMENSIONS IN MM.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

TITLE :- CIRCUIT DIAGRAM MAIN BOARD
DIGITAL MULTIMETER DM131
FROM BATCH 20

DRAWING No. 1ZX0839131

SHEET OF SHEETS

FARNELL INSTRUMENTS LIMITED - SANDBECK WAY - WETHERBY - YORKSHIRE LS22 4DH - TELEPHONE 0937 63541